(12) UK Patent Application (19) GB (11) 2 264 982 (13) A

(43) Date of A publication 15.09.1993

(21) Application No 9304670.4

(22) Date of filing 08.03.1993

(30) Priority data
(31) 4208264 (32) 14.03.1992 (33) DE
4232400 26.09.1992

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(51) INT CL[5]
F01D 17/14, F02C 6/12

(52) UK CL (Edition L)
F1T TGCB T109 T122 T132 T149 T602
U1S S1994

(56) Documents cited
GB 2236806 A EP 0034915 A1 DE 002633587 A
DE 001011671 A US 4688663 A

(58) Field of search
UK CL (Edition L) F1T TGCB TGCX TGE
INT CL[5] F01D 17/00 17/10 17/12 17/14 17/16 17/18

(54) Adjustable flow guide apparatus of a turbocharger

(57) The flow guide apparatus comprises an annular insert 6 between a spiral guide channel 1 of the exhaust gas turbocharger and the runner 2, with a radial or diagonal direction of flow, and wherein the annular insert 6 contains ducts 42 which are distributed over its periphery and which make a flow connection between the spiral guide channel and the runner 2 of the exhaust gas turbocharger. At least one displaceable tubular sleeve part 4, 5 is disposed adjacent to the annular insert 6 provided with the ducts.

The annular insert 6 and the tubular sleeve parts 4, 5 form a one-piece annular adjusting sleeve 3 which is displaceable in the direction of a longitudinal axis of the runner 2.

Through displacement of the sleeve 3 such that the sleeve part 5 substantially shuts off the inlet to the runner 2 turbine overspeeding can be prevented (Fig. 2). Also, during shut off and when used with a T.C. engine a dynamic pressure is built up in the exhaust manifold which acts as an engine brake.

Fig. 1

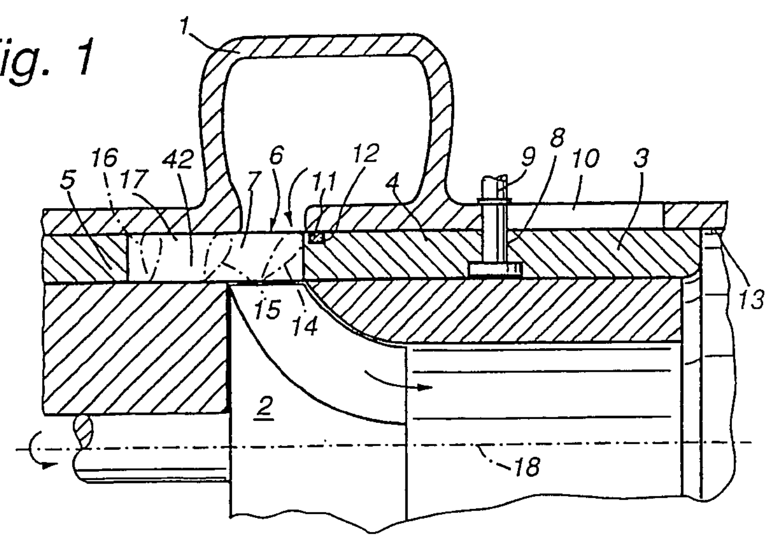

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Fig. 1

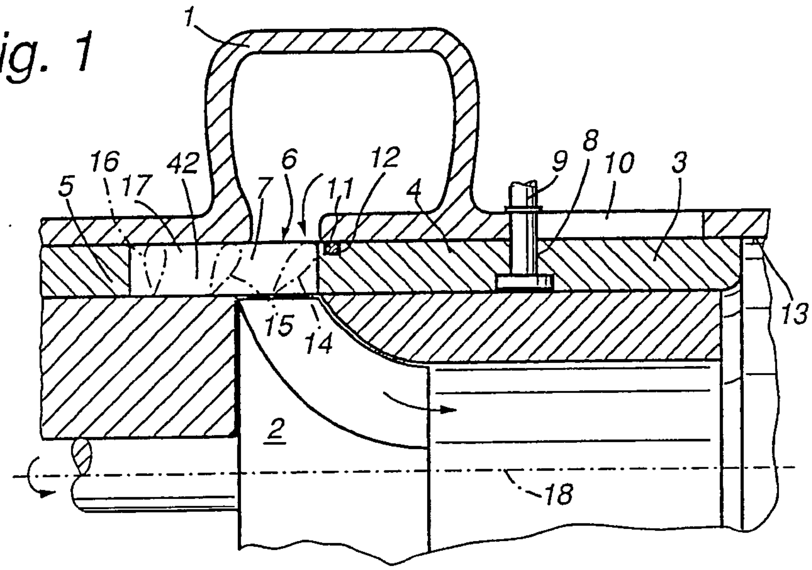
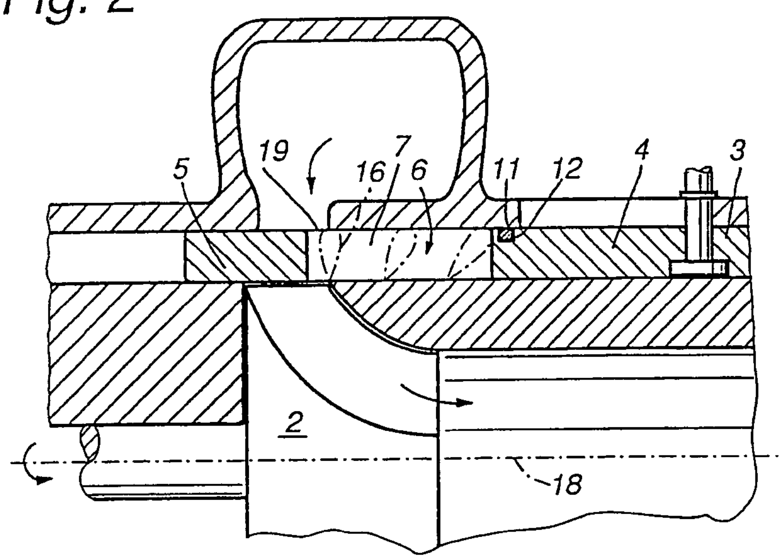


Fig. 2



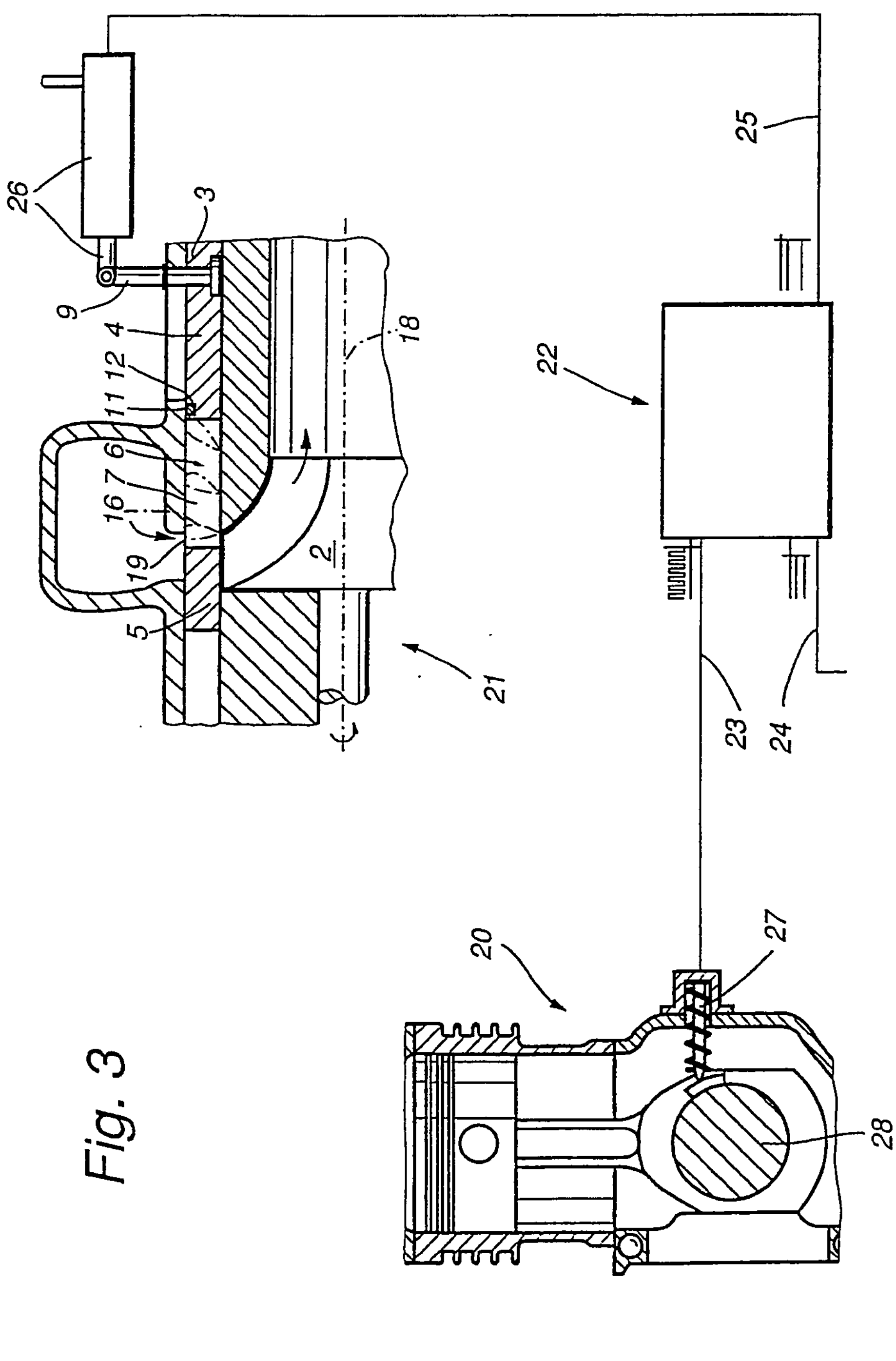


Fig. 3

Fig. 4

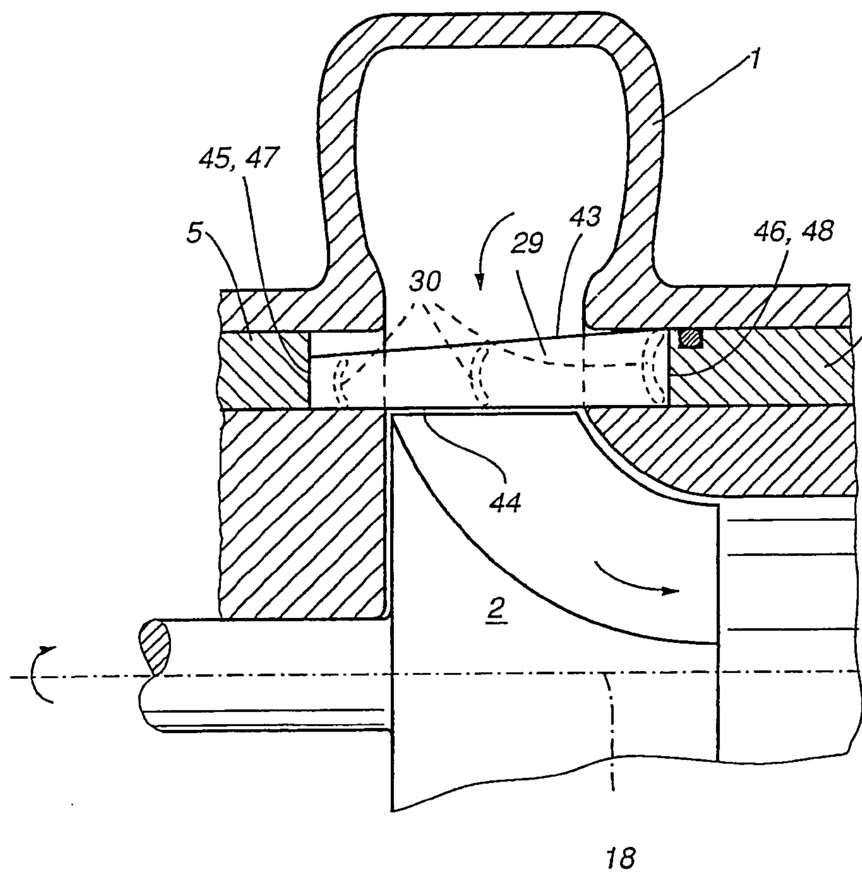


Fig. 5

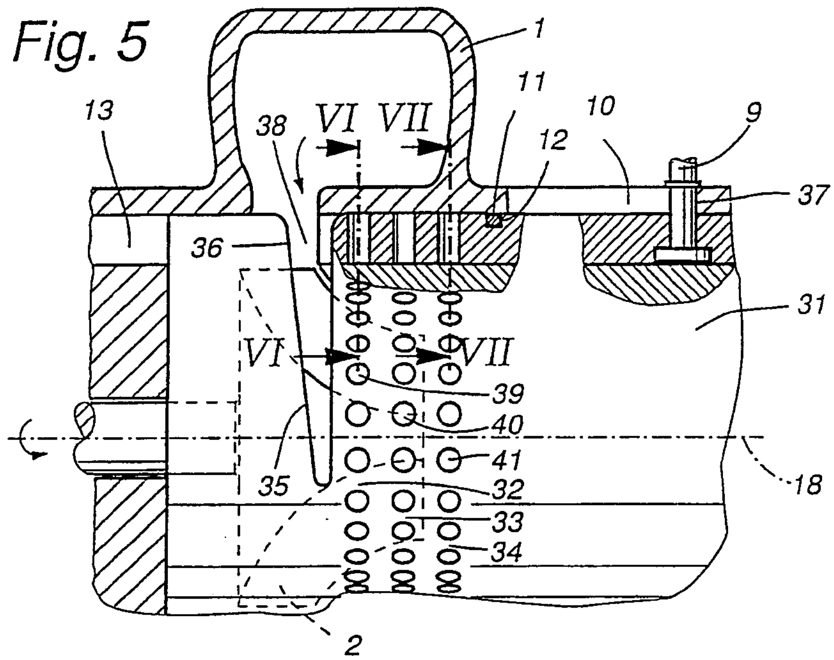


Fig. 6

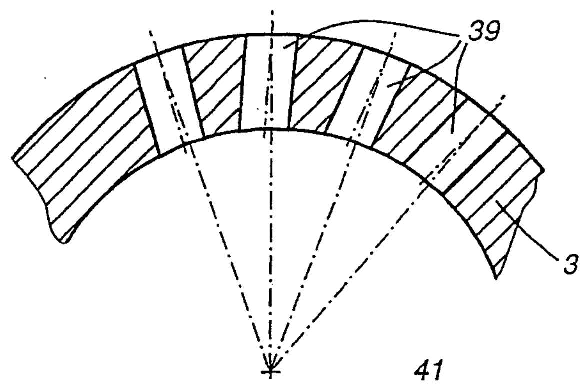
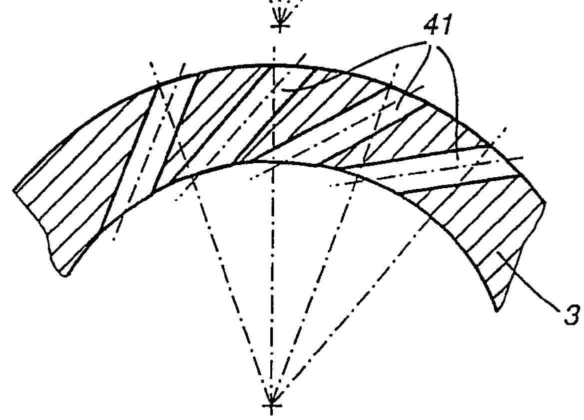


Fig. 7



Adjustable Flow Guide Apparatus.

The invention relates to an adjustable flow guide apparatus for an exhaust gas turbocharger turbine in an internal combustion engine.

DE-OS 28 43 202 already discloses an exhaust gas turbocharger of the generic type, which has a radial wheel surrounded by a spiral guide channel. Between the guide channel and the radial wheel there is disposed an axially fixed annular partition, which has, distributed over its periphery, nozzle-like apertures inclined, out of the direction tangential to the radial wheel, in the direction of the axis of the radial wheel. In front of the annular partition a shield is disposed, which is displaceable in the peripheral direction and by which the cross-section of the nozzle-like apertures can be adjusted.

In addition, DE-AS 1 011 671 already discloses an adjustable flow guide apparatus, in which, in a radial turbomachine, gases are fed via an adjustable guide grid to a runner (radial turbine). The adjustable guide grid consists of a plurality of guide vane rings of different dimensions and/or shape, disposed one behind the other, and is axially movable and manually adjustable.

Furthermore, DE-OS 26 33 587 discloses a tubular sliding device between a dual-flow casing and a runner of an exhaust gas turbocharger of an internal combustion engine. Regulation in the part-load range is here effected by load-dependent shutting-off of one flow. The highest permissible boost pressure is limited by a blow-off slide valve.

US-PS 4 492 520 shows a gas turbine-driven motor vehicle having a radial turbine which is provided with an adjustable guide grid which has a plurality of guide vane rings of different configurations and the axial adjustment of which can be effected in dependence on operating parameters of the engine.

With known adjustable flow guide apparatuses in the form

of guide grids in which it is not possible to cover the vanes by means of a shield, a separate engine brake device must be installed because with guide vane rings disposed axially one behind the other, according to the known prior art, suitable formation of the throttle cross-section by the flow guide apparatus is not possible.

In addition, adjustable flow guide apparatuses of the known type, which are provided with guide vanes, have the disadvantage that only stepwise regulation in respect of the approach flow direction of the runner is possible, so that optimum operation of the turbomachine can be achieved only at certain operating points. It is true that continuous regulation of mass flow by means of an azimuthally displaceable shield mechanism is known,
but this arrangement complicates the construction of the flow guide apparatus because of the larger number of movable parts.

The present invention seeks to provide a flow guide apparatus which has the simplest possible construction in comparison with known flow apparatuses, while the abovementioned disadvantages of the prior art are avoided.

According to the invention there is provided an adjustable flow guide apparatus for an exhaust gas turbocharger turbine in an internal combustion engine,

- wherein the flow guide apparatus comprises an annular insert between a spiral guide channel of the exhaust gas turbocharger turbine and a runner with a radial or diagonal direction of flow,
- and the annular insert contains ducts which are distributed over its periphery,
- wherein the ducts situated in front of a mouth of the spiral guide channel form an inlet flow cross-section and make a flow connection between the spiral guide channel and the runner of the exhaust gas turbocharger turbine,
- and the annular insert together with an adjustable tubular sleeve part forms a one-piece annular adjusting sleeve which is displaceable in the direction of a longitudinal axis of

the runner, wherein, through the axial displacement of the annular adjusting sleeve with the tubular sleeve part lying directly next to the annular insert, the inlet flow cross-section is adapted to be shut off in such a manner that after it has been shut off the latter forms a throttle cross-section of a brake gap for an engine brake.

One advantage of the development according to the invention is that, because of the one-piece formation of the adjusting sleeve of the flow guide apparatus, a substantial simplification of the construction in comparison with previously known solutions is achieved.

Preferably, the throttle cross-section of the brake gap is adjustable in dependence on operating parameters of the internal combustion engine. In this way, continuous optimum regulation of the turbomachine for every load point is achieved. Continuous variation of the guide vane angle is here achieved by means of the twisting of the vanes with an approximately uniform width of the profile. In engine braking operation the vanes are deflected out of the flow and a part of the tubular adjusting sleeve is for the most part pushed over the runner. Problems in respect of the strength of the vanes can thus be avoided even at higher dynamic pressures.

The invention is explained more fully with reference to the example of an exhaust gas turbocharger of an internal combustion engine and to the drawings, in which:

Figure 1 is a partial meridian section of a runner in a casing with a flow guide apparatus in a configuration according to the invention as an adjustable guide grid which is a component of an adjusting sleeve,

Figure 2 shows, in the same arrangement as in Figure 1, an end position of the adjusting sleeve with the guide grid in a position for engine braking operation,

Figure 3 shows schematically the essential elements for the operation of an internal combustion engine with regulation of a brake gap cross-section in dependence on engine speed,

Figure 4 shows the trapezoidal guide vanes according to the invention,

Figure 5 shows the flow guide apparatus with a plurality of rows of holes, disposed axially one behind the other, as flow guide devices, together with the brake gap,

Figure 6 is a section of Figure 5 at right angles to the direction of displacement of the flow guide apparatus, through a row of holes with holes relatively slightly inclined in relation to the radial direction of the flow guide apparatus, and

Figure 7 is a section similar to Figure 6, in the case of a row of holes with holes relatively considerably inclined in relation to the radial direction of the flow guide apparatus.

Figure 1 shows a partial meridian section of a casing 1 with a runner 2 of a turbomachine (not shown in greater detail, for example an exhaust gas turbocharger) which is a component of an internal combustion engine (not shown). Between the casing 1 and the runner 2 is disposed an annular adjusting sleeve 3, which is displaceable axially in relation to a longitudinal axis 18 of the runner and which consists of two tubular sleeve parts 4 and 5 and an annular insert in the form of a guide grid 6 having twisted guide vanes 7. Between the twisted guide vanes 7 twisted channels 42 are thus formed.

A bore 8, receiving a sliding pin 9 guided in a slideway 10, is provided in the tubular sleeve part 4. A linkage (not shown), is articulated to the sliding pin 9 and is in turn connected to a hydraulic or pneumatic actuator (likewise not shown) communicating with the internal combustion engine. By means of this mechanism the adjusting sleeve 3 is guided axially in a slot 13 and can be adjusted in dependence on operating parameters of the internal combustion engine.

The adjusting sleeve 3 is sealed axially by means of a preferably ceramic sealing ring 11, which is inserted in a groove 12 in the adjusting sleeve 3. Through the use of

wear-resistant materials (ceramics), separate lubrication of the sliding surfaces can be dispensed with.

The guide vanes 7 of the guide grid 6 are relatively sharply twisted on the side of the tubular sleeve part 4 (inwardly-turned profile 14). In the position of the adjusting sleeve 3 shown (for example starting position of the internal combustion engine), in which the relatively sharply twisted part of the guide vanes 7 regulates the flow to the runner 2, a relatively slight mass flow is accelerated by the relatively narrow cross-section and, with the strong radial flow to the runner 2 through the sharp twist of the guide vanes 7, a high useful moment on the runner 2 (turbine) is achieved. As a result of the flow constricted in this manner steady full-load operation in the lowest engine speed range is also improved.

The twist of the vanes then decreases continuously in the direction of the tubular sleeve part 5 (inwardly-turned profiles 15 and 16). In a portion 17 preceding the tubular sleeve part 5 the guide vanes 7 of the guide grid 6 are no longer twisted. During full-load operation, the adjusting sleeve 3 is displaced in such a manner that the portion 17 of the guide vanes 7 regulates the incoming flow (opening of the main flow). The main flow is so designed that no additional blow-off valve is needed and surging of the supercharger is avoided.

Figure 2 shows, in the same arrangement as Figure 1, the adjusting sleeve 3 with the two tubular sleeve parts 4 and 5 and the insert in the form of the guide grid 6 with twisted guide vanes 7 in a position for engine braking operation.

Through a displacement of the adjusting sleeve 3 such that the tubular sleeve part 5 to a large extent shuts off the inlet cross-section of the runner 2, the overspeeding of the runner 2 can be prevented.

If the inlet cross-section of the runner 2 is sufficiently shut off, so that only a throttle cross-section 19 remains open, a dynamic pressure is produced in

the exhaust manifold of the internal combustion engine and can be used as an engine brake.

An engine 20 and a part of an exhaust gas turbo- charger 21, which are connected to a control unit 22, are shown schematically in Figure 3.

In dependence on engine speed and the operation of the brake button, by which the driver operates the retarder of his motor vehicle, the control unit controls the position of the flow guide apparatus and hence the cross-section of the brake gap (throttle cross-section 19).

The input signals 23 and 24 of the control unit 22 are the engine speed signal and the brake button operation signal. The output signal 25 is a control signal which controls an actuator 26 connected to the sliding pin 9 of the flow guide apparatus.

The engine speed is obtained from a signal transmitter 27, which inductively detects the revolutions of an engine crankshaft 28 and converts them into an oscillating analog signal. The input signal from the operation of the brake button is essentially a constant threshold signal having only two signal states: "on" and "off".

The output signal 25 resulting from the input signals 23 and 24 depends on the control algorithm of the control unit 22. An appropriate control algorithm is designed such that, at maximum engine speed, the inlet flow cross-section is shut off in such a manner that the exhaust valves are not overloaded by excessively high bottoming speed or by being pressed too far back in the direction of the piston, and that, at low engine speeds, the brake gap is adjusted so as to correspond to the optimum achievable braking power.

Figure 4 shows a partial meridian cross-section of the flow guide apparatus provided with trapezoidal vanes 29, which are fastened to the tubular sleeve parts 4 and 5. The vane 29 is bounded by an inclined vane nose 43, a straight vane end 44, a vane tip 47 having a profile chord 45, and a vane root 48 having a profile chord 46. The vane 29 has no profiling and the median line of the vane 29 is curved

approximately in the form of a circular arc. For each vane 29, a circular arc profile 30, which is shown by dashed lines in the drawing, is thus obtained.

In Figure 5 another exemplary embodiment of the flow guide apparatus provided with a tubular adjusting device 31 is shown. The adjusting device 31 has a plurality of rows of holes 32, 33 and 34 disposed axially one behind the other. On the left of the row of holes 32 is shown a brake gap 35, provided with an oblique control edge 36, in a position of the adjusting device 31 for engine braking operation.

The brake gap 35 forms an elongated cutout of which one of the two section planes forming the cutout extends parallel and the other extends at a slight inclination to a radial plane of the adjusting device 31. The cutout is positioned such that the resulting gap in the periphery of the adjusting device 31 includes the greater part of the peripheral surface. The position of the brake gap 35 is located such that, on displacement of the adjusting device 31 to the right as far as the stop 37, the inlet flow cross-section of the flow guide apparatus is equal to a minimum throttle cross-section 38 of the internal combustion engine.

The rows of holes 32, 33 and 34 consist of holes 39, 40 and 41 uniformly distributed over the periphery of the adjusting device 31, with their centre lines inclined relative to the radial direction of the adjusting sleeve. The inclination of the centre lines of the holes 39, 40 and 41 increases from the row 32 to the row 34, so that those holes whose centre lines are least inclined come to lie in row 32 (see Figure 6), which corresponds to a main flow opening. In row 34 the holes 41 have a relatively great inclination of their centre lines (see Figure 7) in relation to the radial direction of the adjusting device 31 (starting flow opening).

Figure 6 shows a section of Figure 5, at right angles to the direction of displacement of the flow guide apparatus, through the row of holes 32 comprising the holes 39 with a relatively slight inclination in relation to the radial

direction of the flow guide apparatus.

Figure 7 shows a section of Figure 5, at right angles to the direction of displacement of the flow guide apparatus, through the row of holes 34 comprising the holes 41 having a relatively great inclination in relation to the radial direction of the flow guide apparatus.

In a further development of the invention it is possible, with a flow guide apparatus having flow guide devices in the form of a guide grid, for the latter also to be divided into two or more guide grids disposed axially one behind the other in the direction of the longitudinal axis of the runner. The guide vanes of each of these guide grids may have a different inclination in relation to a meridian plane or be twisted.

In addition, the trapezoidal vanes may also be profiled and/or have a twist. In the case of trapezoidal vanes having a profile in the shape of a circular arc it is possible, in a constructional development, to use two-part vanes whose fixed and displaceable parts are movable relative to one another in the direction of displacement of the adjusting device.

Furthermore, the flow guide apparatus according to the invention can also be used in dual-flow and multi- flow turbomachines. In this case, it is only necessary for the shape and dimensions of the ducts in the flow guide apparatus to be adjusted to the desired control behaviour and to the flows of the turbomachine.

In a further development of the control unit according to the invention a continuous or stepped signal may also be produced through the brake button as input signal instead of the constant threshold signal of the brake button. In this way the output signal and hence the engine braking action can be controlled not only in dependence on engine speed, but also as a fine adjustment direct by the driver.

Claims

1. An adjustable flow guide apparatus for an exhaust gas turbocharger turbine in an internal combustion engine,
- wherein the flow guide apparatus comprises an annular insert between a spiral guide channel of the exhaust gas turbocharger turbine and a runner with a radial or diagonal direction of flow,
- and the annular insert contains ducts which are distributed over its periphery,
- wherein the ducts situated in front of a mouth of the spiral guide channel form an inlet flow cross-section and make a flow connection between the spiral guide channel and the runner of the exhaust gas turbocharger turbine,
- and the annular insert together with an adjustable tubular sleeve part forms a one-piece annular adjusting sleeve which is displaceable in the direction of a longitudinal axis of the runner, wherein, through the axial displacement of the annular adjusting sleeve with the tubular sleeve part lying directly next to the annular insert, the inlet flow cross-section is adapted to be shut off in such a manner that after it has been shut off the latter forms a throttle cross-section of a brake gap for an engine brake.

2. An adjustable flow guide apparatus according to Claim 1, wherein the throttle cross-section of the brake gap is adjustable in dependence on operating parameters of the internal combustion engine.

3. An adjustable flow guide apparatus according to Claim 1 or 2, wherein the ducts are formed by at least one guide vane ring having twisted guide vanes.

4. An adjustable flow guide apparatus according to any one of Claims 1 to 3, wherein the profile length of the profiles in the longitudinal direction of guide vanes formed in the

annular insert varies continuously in such a manner that the area defined by the vane nose, the vane end and by the profile chords has approximately the contour of a trapezium.

5. An adjustable flow guide apparatus according to any one of Claims 1 to 3, wherein the guide vanes have no profiling and the median line of the guide vanes is curved approximately in the shape of a circular arc.

6. An adjustable flow guide apparatus according to any one of Claims 1 to 5, wherein the guide vanes of the guide grid consist of a fixed part which is integrated in the casing, and of a displaceable part which is connected to the annular insert.

7. An adjustable flow guide apparatus according to Claim 1 or 2, wherein the ducts consist of holes distributed over the periphery of the adjusting device with an inclination of their centre lines in relation to the radial direction of the adjusting sleeve.

8. An adjustable flow guide apparatus according to any one of Claims 1 to 7, wherein a part of the flow guide apparatus is in the form of a piston which is hydraulically regulatable.

9. An adjustable flow guide apparatus according to any one of Claims 1 to 8, wherein the flow guide apparatus is provided on its periphery with at least one oblique control edge.

10. An adjustable flow guide apparatus for an exhaust gas turbocharger turbine in an internal combustion engine, substantially as described herein with reference to and as illustrated in the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

A lication number

GB 9304670.4

Relevant Technical fields

(i) UK Cl (Edition L) F1T (TGCB,TGCX,TGE)

(ii) Int Cl (Edition 5) F01D 17/00,17/10,17/12,17/14, 17/16,17/18

Search Examiner

M D WALKER

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

19 APRIL 1993

Documents considered relevant following a search in respect of claims ALL

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2236806 A (LEAVESLEY) Figure 1; page 12 lines 1-25	1,3,6,8,9
Y	GB 2236806 A	4,5,7
X	EP 0034915 A1 (HOLSET) page 7, lines 1-13	1,2,6 AT LEAST
Y	EP 0034915 A1	3,8
Y	US 4688663 (MARCHAND) Figures 2,5,6,7,8 column 9, lines 28-62	2-5,7,8
X	DE 2633587 A1 (KLOCKNER) Figures 1-3, 6	1, 2
X	DE 1011671 A (POWER JETS) Figures 1-3	1,4,5

Category	Identity of document and relevant passages	Relevant to claim(s)

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